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OPERATING
AND
SERVICE MANUAL

MP MASTER
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LYONS INSTRUMENTS

O P E R A T I N G A N D S E R V I C I N G M A N U A L

TYPE PG-25

PULSE GENERATOR

Serial No. 10044

Design and manufactured in England by:

L Y O N S I N S T R U M E N T S L I M I T E D

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INTRODUCTION

The Lyons Instruments type PG-25 is an all silicon solid-state pulse generator providing rise and fall times better than 10 nanoseconds, repetition rates from 1 Hz to 10 MHz, single or double pulse (20 MHz effective single pulse rate), or square wave, and wide range control of pulse width (30 ns to 200 ms) and delay (-10 ns to +200 ms). Independent normal/complement facilities on each channel provide duty cycles up to 100%, and the output circuits are fully short-circuit protected. Each output is variable up to 50 volts into 50 ohms or 1 amp into the external load denoted by the output switch (Current mode).

The input circuits of the PG-25 permit external drive from D.C. to 10 MHz, synchronous-start gating, manual one-shot operation, or synchronisation of the internal oscillator to frequency ratios as high as 100 to 1. On external drive the comprehensive slope, sensitivity and threshold controls enable triggering or gating to occur at a selected point on the trigger waveform. The sync. output is provided with a variable width control.

The PG-25 is a state of the art instrument employing high quality components throughout, including silicon semi-conductors and glass epozy printed board. Forced air cooling has been used and care should be taken to avoid any restriction of air flow through the ventilators provided.

This manual contains information on the operation, application and maintenance of the instrument. While we have attempted to make it as comprehensive as possible, our Engineering Department will be pleased to advise on any points relating to customers individual applications or requirements.

Lyons Instruments products are subject to a one year guarantee. Details of this are given in Section 6 of this manual.

SECTION 1

SPECIFICATION

1.1.	Pulse Amplitude	50 volts into 50 ohms ±5% from simultaneous positive and negative outputs. Amplitude variable to 1·5 volts in four 6 db attenautor steps plus vernier control of 2:1 range. Both outputs are short circuit and open circuit protected. Duty cycle up to 100% obtainable. (50 watts continuous).
1.2.	Pulse Shape	Rise time less than 10 nanoseconds. Fall time less than 10 nanoseconds. Overshoot and ringing less than 5% of amplitude (minimum setting less than 7%).
	Note:	1.1. and 1.2. apply only when outputs terminated with 50 ohms via cable of that impedance.
1.3.	Pulse Width	Variable from 30 ns to 200 ms in seven ranges plus vernier control. Jitter less than 0·1% of value +0·4 ns.
1.4.	Delay	Variable from -10 ns to +200 ms with respect to the sync. pulse output. Jitter less than 0·1% of value +0·4 ns.
1.5.	Sync. Pulse	2 volts positive into 50 ohms, at clock or external repetition rate. Width variable 15 ns to 90 ns. (These figures are typical).
1.6.	Pulse Mode	
	1.6.1. Normal	Output pulse width and delay controllable in conventional manner.
	1.6.2. Complement	Outputs inverted but not shifted with respect to ground. The operation of width control reversed.
	1.6.3. Single Pulse	One output pulse appearing at each output per period.
	1.6.4. Double Pulse	Output pulses occurring in pairs, one pulse at each output at a fixed delay with respect to the sync. pulse, the second pulse variable in delay by means of Delay controls.
	1.6.5. Square Wave	Output pulses at clock rate, symmetry adjustable ±7% giving square waves. Width and Delay circuits inoperative.

1.7.	Repetition Rate	1 Hz to 10 MHz in seven decade ranges plus vernier. 20 MHz available in double pulse mode. Jitter typically less than 0·1% of period +0·3 ns.
1.8.	External Input	
	1.8.1. Sensitivity	1V peak into high impedance (1kΩ, 27 pf. approx).
	1.8.2. Threshold	+2V to -2V adjustable at the front panel.
	1.8.3. Slope	Negative or Positive selectable at the front panel.
	1.8.4. Sync.	Rate generator synchronised to external signals over a ratio up to 100:1. Pull in range typically 10% of set frequency.
	1.8.5. Gate	Synchronous gating of the rate generator by means of external signals. Sensitivity, etc., as 1.8.1. and 1.8.2.
	1.8.6. External	Input socket protected to ±50V at 25% duty cycle and 30V D.C.
1.9.	Power Requirements	240 or 220V ±10% 50-60 Hz 300 watts.
1.10.	Weight	45 lbs.

SECTION 2

DESCRIPTION OF CONTROLS

2.1. WARNING Do not directly connect the outputs of the PG-25 to other outputs or voltage sources.

WARRANTY The instrument is subject to a one-year warranty, effective at our works, full details of which are available on request.

On receipt of the instrument please check for signs of mechanical damage in transit. Should such damage be evident, do not attempt to use the instrument, and contact Lyons Instruments Limited, or their agent in your country immediately. Do not attempt to repair or return the instrument without first contacting us.

2.2. Controls and Connectors - General.

The controls of the PG-25 provide a large number of configurations in the use of the instrument. As with all variable pulse generators, it is possible to set the controls in a manner where the settings are not compatible with each other, for instance selecting too high a repetition rate for the set width and/or delay. Such settings must be avoided if proper results are to be obtained.

A brief description of each control and its operation follows.

2.3. Power Switch. POWER

The POWER switch connects AC to the mains transformer primary when pushed upwards. The pilot lamp lights and the sound of the cooling fan should be heard.

2.4. FREQUENCY

The rotary switch of this dual concentric control selects one of the seven repetition rate ranges. The vernier control provides continuously variable settings for all ranges. Fully clockwise rotation of this control sets the highest frequency per range and overlap at each range setting is provided.

2.4.1. Gate/Sync/Ext - Slope - Threshold - Manual

The three position rotary switch selects the mode of operation of the rate generator. The GATE position provides synchronous gating facilities by means of an an external signal applied to the BNC socket marked EXT. In the SYNC position, the rate generator is synchronised to the external signal over a 100:1 range whilst in the EXT position the rate generator is inhibited permitting its replacement by an external source or enabling the user to obtain single pulse operation by means of the MANUAL button. The SLOPE control allows the selection of either the positive or negative going edge of an incoming signal and the input threshold level may be varied by preset T.

2.5. DELAY

The DELAY rotary switch selects one of seven ranges and the concentric vernier provides continuously variable control and overlap for each range. Clockwise rotation of the vernier control sets the minimum delay at each range.

2.6. WIDTH

The WIDTH rotary switch operates in the same way as the DELAY control; fully clockwise rotation of the vernier control sets the minimum pulse width on each range.

2.7. DP/DELAY/SQ. WAVE

2.7.1. This rotary switch selects on of three modes of operation of the PG-25. The DELAY (single pulse) position selects the single pulse mode where one output pulse occurs at each output for every clock period and the DELAY range has a negative minimum limit with respect to the sync. pulse.

2.7.2. The DP position selects the double pulse mode which allows an effective output pulse rate of 20 MHz to be obtained by producing two output pulses during every clock period, the first being coincident within 5 ns with the trigger pulse, whilst the time relation of the second to the trigger pulse is set by the DELAY control. The width of both pulses is variable by means of the WIDTH control.

2.7.3. In the SQ. WAVE position, the width and delay controls are inoperative and the outputs are in the form of a square wave. Symmetry is adjustable at the front panel (SYM ADJ).

2.8. NORMAL/COMPLEMENT

These two slide switches cause the pulses fed to the output stages to be inverted whilst retaining their ground reference. Thus, in the NORMAL mode, operation of the WIDTH control is as described in 2.6. In the COMPLEMENT mode, the effect of the WIDTH control is reversed, allowing very large duty cycles to be obtained at either output.

2.9. AMPLITUDE

These dual concentric controls allow the outputs to be continuously varied over a 30 db range: outputs must be terminated in 50 ohms.

2.10. OUTPUT

The two BNC sockets provide the output connections of the instrument.

2.11. SYNC AND SYNC WIDTH

This BNC socket supplies the reference trigger pulse at the clock rate (or external signal rate). The SYNC WIDTH control varies the width of the sync. pulse, fully clockwise rotation giving minimum width.

2.12. VOLTAGE/CURRENT MODE SWITCHES

Two switches are provided, one for each channel. In the VOLTAGE mode the generator output is as in 1.1. When switched to CURRENT mode the output becomes a 1 ampere current source variable down to 0·5A by use of the appropriate vernier control. The COARSE amplitude control then determines the load impedance (dial reading ±2·5Ω).

2.13. EXTERNAL LOAD (CURRENT MODE)

In the CURRENT mode the PG-25 is designed to supply up to 1 ampere into external loads of 10, 20, 30, 40 or 50 ohms as determined by the coarse amplitude control. Intermediate impedance values may also be driven by using external padding resistors (i.e. load + padding resistor = coarse control setting).

2.14. OVERLOAD PROTECTION

The PG-25 is fitted with an automatic overload protection system which disconnects the pulse source from the output and lights a warning indicator. Immediately the overload is removed the circuit resets itself and hence a continual overload is indicated by the lamp flashing.

Overload indications can occur during normal operation i.e. during the warming-up period (approx. 5 minutes), when carrying out certain switching functions, or when one output is left unterminated. In this latter case the relevant coarse attenuator should be switched to one of the attenuated output positions: in other cases, provided that the overload condition is of a temporary nature the indication can be ignored.

If the warning lamp continues to flash then an overload is present. This can be due to incompatible generator settings or load conditions causing a reduction of pulse amplitude by greater than 5%.

SECTION 3

FUNCTIONAL VERIFICATION

3.1. WARNING (i) The instrument is intended for driving resistive loads at ground potential. The output protection circuits are calibrated to detect 5% changes in load resistance and for correct operation at maximum output close tolerance loads should be used.

(ii) The user is advised that the PG-25 is capable of delivering 50 watts continuous power on each channel and incautious use of controls will damage low power terminations (e.g. switching to Complement, increasing width or frequency etc). Please use terminations of sufficient power handling capability at all times.

ACCIDENTS WILL HAPPEN

3.2. The purpose of this section of the manual is to help the user during 'first time' operation of the instrument both in checking that no damage has occured during transit and to help in becoming familiar with the action of the front panel controls. The equipment required for the checkout of the PG-25 is as follows:-

3.2.1. A general purpose oscilloscope of vertical bandwidth greater than 15 MHz, having double beam and external trigger facilities and having vertical signal delay.

3.2.2. One 50 ohm co-axial termination capable of 50W dissipation, 50 ohm co-axial termination capable of 1/2W dissipation.

3.2.3. 3 BNC-BNC cables.

2 BNC-T connectors.

3.3. Test Connections and Settings

3.3.1. Connect the positive output socket via 50 ohm cable to the 50W termination and T connectors at the oscilloscope vertical inputs. Switch negative attenuator to one of the attenuate positions.

3.3.2. Connect SYNC OUT via 50 ohm cable and terminated T-connector to the external trigger socket of the oscilloscope.

3.3.3. Connect power cable to mains supply.

BROWN OR RED	-	Live
BLUE OR BLACK	-	Neutral
YELLOW/GREEN OR GREEN		Earth.

3.3.4. Set the instrument controls as follows:-

POWER	Off
FREQUENCY	100K-1M
Vernier	Clockwise
DELAY	0-0·2μS
Vernier	Clockwise
WIDTH	0·2 - ·02μS
Vernier	Midway
GATE/SYNC/EXT	SYNC
SP/DP/SQ. WAVE	SP
NORMAL/COMPLEMENT	Normal
+ AMPLITUDE SWITCH	Maximum
- AMPLITUDE SWITCH	12 - 25V
VERNIERS	Clockwise
SYNC WIDTH	Clockwise

Set the oscilloscope sweep speed to 0·1 μS/cm and vertical sensitivity to 20V/Div DC coupled. Centre trace.

Proceed as follows:

3.3.5. Pulse Output

Turn POWER switch on, checking for the sound of cooling fan and noting that red pilot lamp lights. The unit requires approximately 3 minutes warming up time during which the overload indicator may flash. A rectangular pulse approximately 50V amplitude and approximately 100nSec wide will appear on the screen. (The trigger controls of the oscilloscope may need adjustment).

Check AMPLITUDE control vernier, 50V maximum and a minimum of 25V on the 25-50V range.

Return AMPLITUDE vernier to clockwise position and check attenuator steps. Return to top range.

Repeat for negative output with positive output switched to a low amplitude.

N.B. Reduce pulse output amplitudes to 6-12 volts with verniers anti-clockwise for remaining tests. Increase oscilloscope' sensitivity accordingly.

Switch from NORMAL to COMPLEMENT on both channels and note both pulses are inverted but remain at the same polarities with respect to ground. Return to NORMAL mode.

Turn pulse WIDTH vernier from one extreme to the other, note pulse width changes smoothly. Return vernier to midway position.

Turn DELAY vernier from one extreme to the other Note pulse moves from left to right.

Return to original position (clockwise).

Turn FREQUENCY control anti-clockwise and switch to 1 - 10 MHz. Now turn FREQUENCY vernier clockwise until several pulses appear on the screen, one at each end.

3.3.6. Double Pulse Mode - Square Wave Mode

Switch to DP. Turn DELAY vernier anti-clockwise until a second pulse appears after the first on the screen. Check that WIDTH vernier alters the width of all three pulses now on the screen. Now switch to SQ. WAVE and adjust oscilloscope time base and FREQUENCY vernier until one complete cycle appears. Check symmetry control SYM allows you to vary the mark to space ratio ±7% of period. Return to SP mode.

3.3.7. Manual Operation

Reset the instrument controls as follows:-

GATE/SYNC/EXT	EXT
DELAY Vernier	0-0·2μS Clockwise
WIDTH Vernier	0·2 - 2mSec Midway
SLOPE	+VE
NORMAL/COMPLEMENT	NORMAL
SP/DP/SQ. WAVE	SP
AMPLITUDE	6-12V
VERNIERS	Anti-clockwise.

Set oscilloscope time-base to 1mSec/cm and operate the MANUAL button. A single pulse will appear at each output whenever the MANUAL button is pressed.

Set SLOPE to negative, a single pulse will appear whenever the MANUAL button is released.

3.3.8. External Trigger

For the next test a square wave source of approx. 2V amplitude is required (such as the oscilloscope calibrator output). With the PG-25 controls set as previously, apply a 1 KHz square wave of more than 1V peak amplitude to the input jack of the pulse generator.

Connect the oscilloscope external trigger socket to the square wave source using a 'T' connector. Adjust the oscilloscope for a stable display.

A pulse will appear at each output of the pulse generator which will shift one half of a calibrator period when the SLOPE switch is operated.

3.3.9. Gated Operation

Retain the set up of 3.3.8. Set the instrument controls as follows:-

FREQUENCY	1-10 KHz
Vernier	Clockwise
DELAY	0-0·2μS
Vernier	Clockwise
WIDTH	20-2μS
Vernier	Anti-clockwise
GATE/SYNC/EXT	GATE
SLOPE	+VE
SP/DP/SQ.WAVE	SP
SYNC WIDTH	Clockwise
AMPLITUDES	6-12 volts
Verniers	Anti-clockwise
NORMAL/COMPLEMENT	Normal

Apply a 1 KHz square wave of greater than 1V peak amplitude to the EXT input jack as in 3.3.8. A group of pulses will appear followed by a space. Group and space are interchangeable by the operation of the SLOPE switch.

Turn the selector to SYNC and note that pulses are continuous. Turn to EXT and note pulses are at the rate of external drive and that the FREQUENCY controls are inoperative.

SECTION 4

OPERATION

4.1. Idle Output

When only one output is being used, radiation from the other may cause ringing of the output in use. This can be conveniently avoided by reducing the amplitude of the idle output by means of its attenuator switch so that it is terminated by the impedance of the attenuator.

4.2. Output Termination

To get clean waveshapes with fast transition times, both the interconnecting cables and the load termination must have an impedance of 50 ohms. The termination should be placed at the far end of the cable rather than at the instrument end. Terminating at the pulse generator or using co-axial cable of the wrong characteristic impedance or using clip leads will have detrimental effects on pulse shape and transition times. The output termination should be as close to the item under test as possible, or the monitor oscilloscope as applicable. Any discontinuity (including oscilloscope input impedance) will cause an increase in pulse aberrations.

4.3. Nonlinear Loads

Operating directly into nonlinear devices such as transistors and diodes that exhibit varying impedances in opposite directions causes waveform distortion. This can be prevented by terminating the pulse generator in a network that reflects uniform loading in both directions. A suggested method of driving the base of a transistor is to provide a stand off resistor in series with the base, a bias return resistor and a termination, the three valves being adjusted to provide a 50 ohm termination for the pulse generator.

4.4. Reactive Loads

Such loads connected directly to the output will cause pulse distortion. Inductive loads may damage the instrument. The instrument should be protected against inverse voltages generated by energy stored in an inductor or transformer. Diodes should be used to dampen the inverse swings and prevent the output transistors from being exposed to voltages above their inverse ratings. Capacitive loads greater than 200pf should be avoided.

4.5. Duty Cycle

If high duty cycles are required, use may be made of the COMPLEMENT facility of the instrument which reverses the effect of the width controls and allows the width circuits to operate at short recovery times. The user is however advised to take care and ensure that terminations are capable of handling the output power required.

SECTION 5

CIRCUIT DESCRIPTION

For ease of construction and maintenance the bulk of the electronic circuits of the PG-25 are mounted on five printed circuit cards, comprising respectively the rate generating circuit (card 25/1), width and delay circuits (25/2), output circuits (25/3), attenuator (25/5), and power supply regulators (25/4).

5.1. Input Circuit and Rate Generator

The input and rate generating section consists of a Schmitt trigger and free-running multivibrators which are used to provide the basic pulse or square waves required to drive the width/delay section. When the instrument is operated in its External mode, the input frequency fed via the Schmitt circuit determines the rate of operation of the generator.

If the Gate or Sync mode is selected, the free running multivibrator determines the repetition rate, which can be 'pulled' by an external input (if present) in the sync mode and 'interupted' in the Gate mode. The rate generating circuitry is housed on card 25/1 and provides four outputs, comprising a square wave derived directly from the free-running multivibrator which is capable of symmetry adjustment, and three further outputs which are used to drive the width, delay and sync pulse generators on the following card. One of these outputs may be inhibited by operating Single/Double pulse selector switch so that the width generator on card 25/2 can be driven either once or twice during each clock period.

Referring to the circuit diagram of card 25/1 it can be seen that Q1 to Q3 form the external input Schmitt trigger, the input signals being applied to pin 1. D1 and D2 act as input protection clamps. The manual control push button operates into pin 2 and its position in the circuit gives the system a manual gate facility as well as single shot operation. Threshold may be adjusted between ±2V and sensitivity is fixed at greater than 1V peak.

Q4 and Q5 form the slope selection inverters and their outputs are routed via the selector to either the rate generator itself when SYNC or GATE modes are selected or to the output drivers when 'EXT' is selected.

Q6 and Q13 form the rate generator, Q9 and Q10 being variable current sources providing vernier control in the pulse mode and symmetry adjustment for square wave operation.

Q8 inhibits the clock either for the duration of a differentiated Schmitt trigger output during Sync operation, or for the duration of the gating waveform when the Gate mode of operation is selected. Q11 is a 'kicker' which monitors both phases of the rate generator and ensures clock starting under all conditions.

Q14 is an output driver which is selected during square wave operation of the instrument.

Q15 and Q16 form an OR function, accepting either the rate generator signals or the external signals via the Schmitt and selector switch into pin 23. The output of the OR gate drives the three current sources providing outputs to the next card of which Q17 can be inhibited for single pulse operation.

5.2. Width Delay Generator

The pulse width, delay and sync output is housed on card 25/2 section and contains three monostable multivibrators. The first of these forms the delay generator which is triggered once per clock period, an output being derived from the back edge of its output waveform, which in turn triggers the width generator in the single pulse mode. During double pulse operation, the width generator accepts a second trigger per period derived directly from the rate generator (Q17) and which is not delayed so that two pulses for each clock period appear at the output of the width monostable.

The third monostable circuit is the sync pulse generator which gives an output of variable width into 50 ohms. During single pulse operation the input of the sync pulse generator is delayed by 90nS by means of a fixed delay line enabling the output pulse delay to be set negative with respect to the sync pulse output. During double pulse operation the delay line is switched out so that the first pulse of each pair is coincident within 5nS of the sync pulse output. The three monostable circuits are similar. Referring to circuit 25/2 it can be seen that Q1 and Q2 form a fast trigger generator, producing pulses of 5V amplitude and some 15nS duration. The trigger pulses are applied to emitter follower Q5 and via the timing capacitor C7 to Q4. This stage turns off and variable current source Q3 produces a linear discharge of the timing capacitor, providing vernier control. Q6 provides the inversion necessary to complete the loop and the output of the monostable appears at its collector. Q7 inverts the pulse and shapes it to drive the fast trigger generator Q8, Q9. During double pulse operation an identical trigger circuit Q17 Q18 receives inputs from the rate generator card the two triggers being mixed at the collectors of Q11 and Q9 and fed to the width generator Q12 to Q15; which is identical to the delay generator described above. The output of Q15 drives the grounded base amplifier Q16 used to provide output signals to the next card via pin 13.

The sync pulse generator consists of the standard trigger circuit Q17, Q18 followed by a single range variable monostable Q19 to Q21 providing sync pulse width variation. C24 is the timing capacitor and varying voltage applied via pin 15 to R46 completes the rest of the timing elements.

Q22 is an emitter follower driving the panel mounting co-axial connector via pin 16 providing the sync pulse output.

5.3. Output Stage

The main output stages of the PG-25 comprise three basic circuits:-

(i) Positive Output and Protection circuit.

(ii) Negative output and Protection circuit.

(iii) Common overload and Indicator circuit.

5.3.1. Positive Output and Protection

The signal input is applied to Pin 1 and the emitter follower Q1 to feed the current switch Q2, Q4 and Q3, Q3 providing the emitter current source. The base of Q3 is connected to the amplitude vernier control and provides the necessary control over the collector amplitudes of Q2, Q4. Q2 and Q4 outputs provide the complement and normal outputs respectively feeding the series gates Q6 and Q7 which also provide the necessary 16V to 51V (nominal) level shift for further amplification. Q7 also has a preset trimmer R12 in its base circuit which allows the gain of the output to be preset when operating in the NORMAL mode.

The base of Q6 or Q7 is connected to 0 volts or a positive level (18 to 22V, set by R6) via the Normal/Complement switch and the selected output from Q6, Q7 collector is coupled via the compound emitter follower Q8, Q9 to the main output devices Q13, Q15, Q17.

These last three transistors are operated as non-saturated switches each handling approximately one third of the output power. The maximum permissible Vce is 6 volts and this is maintained through all amplitude settings by varying the 55 volt rail together with base voltage of Q3, by a second potentiometer mounted on the output vernier control.

The collectors of Q13, Q15, Q17 feed the output pulse to the attenuator switch and also a sampling circuit D2, R33 which compares the output pulse amplitude with the +43 volt supply.

The difference potential is then fed to the base of current switch Q10, Q11 which provides an effective detector circuit for further comparison to a fixed level set by R26 (Protection Set). The collector of Q11 feeds the base of comparator Q12 where the signal is compared with the output of Q14, i.e. a signal proportional to the output stage drive signal.

Q10, Q11, Q12 and Q14 form the basic overload protection circuit and Q11 base is set such that the switch Q10, Q11 is just operating under normal conditions thus if the output level falls by more than 5% below that specified, Q10, Q11 will fail to operate, causing Q12 to changeover and so provide an output pulse to Q16 and emitter follower Q18. Q18 emitter is coupled to Q5 which turns 'on' under overload conditions and shorts the collector load of Q6, Q7 and hence removes any drive to the output switches, protecting the transistors from excessive volts drop.

It will be seen that once Q5 has operated and removed the output pulse, the protection circuit will reset itself and provided the source of overload has been removed the generator will operate normally. Under prolonged overload conditions the protection system will continue to operate in a make and break fashion at a natural frequency of approximately 2 MHz, causing the output pulse to be "chopped" into narrow pulses approximately 250nSecs wide.

It should be noted that this effect will occur when any incompatible setting is present on the generator or if for any reason the output pulse amplitude is reduced by greater than 5% due to distortion of the pulse.

5.3.2. Negative Output and Protection

The negative channel may be considered identical as far as the operation is concerned and that only the supply polarities and device types Q19 to Q36 inclusive are different.

5.3.3. Overload Indicator Circuit

Q37 and Q38 are connected as a simple monostable with a period of approximately 1 second. The monostable is triggered by the output of Q16 or Q34 when either channel is oyerloaded providing a drive pulse for the emitter follower Q39 and its associated overload indicator.

5.4. Power Supplies

The power supplies consist of the conventional transformer bridge rectifier, reservoir capacitors and regulator amplifiers. All low power supplies are mounted on a printed circuit board, but series regulators and power zeners are mounted on heat sinks HS1-3, inclusive, in the direct air flow of the cooling fan.

The printed circuit board is fitted to a hinged framework for ease of servicing and calibration.

The complete power supply consists of 9 separate supplies.

(i)	+55 volts (variable)	(vi)	-55 volts (variable)
(ii)	+43 volts (variable)	(vii)	-43 volts (variable)
(iii)	+22 volts (preset)	(viii)	-22 volts (preset)
(iv)	+12 volts (fixed)	(ix)	- 7 volts (fixed)
(v)	+ 7 volts (fixed)		

5.4.1. +55 Volts

The regulator Q19 is driven from the full wave rectifier D14 and capacitors C11, C12 when RL1 is energised. Q14 to Q20 inclusive form the regulator amplifier with Q14, Q20, Q17, Q18 providing the stabilising system and Q15 Q16 providing the current sensing and protection network.

Q18 base is controlled by the positive pulse amplitude vernier to give the necessary changes discussed in para.5.3.1. RL1 is included to remove accumulated charge on the reservoir capacitors immediately the unit is switched off and so prevent damage to the instrument when the supply is re-connected.

5.4.2. +43 Volts

This supply is derived directly from the +55 volt line via zener D21 and R49 and will vary in accordance with the +55 volts to maintain the correct operating conditions for the overload protection circuit (5.3.1.).

5.4.3. +22 Volts

This is derived from a 27·5 volt winding on the mains transformer and bridge rectifier D3, Q6 is the error voltage amplifier and Q5 Q7 supply the output current with Q9 D6 and R21 providing over-current protection and current source for Q6.

5.4.4. +12 Volts

This is a low current and power supply and all regulator components are mounted on the printed circuit board. Bridge rectifier D1 supplies approximately 20 volts to the reservoir capacitors C1, C2 with Q1, Q2 and Q3 forming a simple regulator system.

5.4.5. +7 Volts

This is provided by regulator Q8 and its associated components D8 R17 and is derived from the +22 volt supply.

5.4.6. Negative Supplies (-55V, -43V, -22V, -7V)

These may be considered to be the exact complement of the equivalent positive supply rails.

SECTION 6

MAINTENANCE

6.1. Warranty

Lyons Instruments Limited guarantees each instrument manufactured by us to be free from defects in material and workmanship for a period of one year from date of delivery to the original purchaser. Repair during this time will be made by us free of charge if the instrument is returned to our works carriage paid.

Excluded from this guarantee are valve replacements, as well as all damages caused by, or related to, abuse of the instrument either electrically or mechanically. In this case repairs will be charged at cost and as estimate will be submitted for approval before the work is started. Output transistor replacement if required is not normally included in the terms of the guarantee.

If an instrument is believed to be defective, please notify our Service Department, giving the model and serial number of the instrument, as well as a description of the nature of the fault. Our Service Department will then, if necessary authorise the return of the instrument under the terms of this guarantee and advise how shipment should be made.

6.1.1. Claim for damage in shipment

If, on receipt, the shipping cartons show evidence of rough treatment, entry should be made on the carrier's delivery receipt indicating this condition.

As each instrument is unpacked, it should be inspected to ascertain that no damage has occurred during shipment. If no damage is visible, operational checks should be performed to make sure that the instrument is in its original operating condition. If any damage is revealed, a claim should be filed immediately with the carrier, stating the extent of the damage. A copy of this report should be forwarded to Lyons Instruments together with the model and serial number of the instrument. We will then advise how the instrument should be returned for repair or replacement.

6.1.2. Shipping instructions for returning instruments under guarantee

No instrument should be returned to the factory without prior authorisation from Lyons Instruments Limited.

Shipping instructions will be given at the time return of an instrument is authorised. In all cases the instrument should be packed in a strong container and surrounded by adequate shock-absorbing material.

Transit insurance covering the instruments being returned to Lyons Instruments should be effected by the sender.

6.2. Routine Maintenance

The PG-25 is fan cooled and when used in dusty environments the air intake must be checked at regular intervals to ensure adequate air flow. In very hot conditions, the fan motor may require oil at 12 monthly intervals, remove instrument top cover and place no more than two drops of light oil on to the top bearing inner sponge.

WARNING - ACCIDENTS WILL HAPPEN

FOR THESE TESTS 50 OHM LOADS WITH AN ACCURACY OF ±1% AND POWER RATING OF 50 WATTS ARE NECESSARY, LOW POWER LOADS MAY ONLY BE USED WITH REDUCED GENERATOR DUTY CYCLES AND THEN AT THE USERS RISK.

6.3. Calibration

The PG-25 has been designed to have a minimum of internal adjustments. The frequency, width and delay controls have ranges considerably in excess of the 10 to 1 requirements and therefore there is no need for upper and lower limit range settings. The remaining potentiometers are concerned with power supply settings and output stage 'on' currents and should require adjustment at twelve monthly intervals or after any necessary repair work. Details of the adjustments are as follows, but output stage adjustments should not be made unless known 50 ohm ±1% loads are available. Damage caused by incorrect adjustment is not included in the warranty terms.

6.3.1. Power Supplies

Set controls to COMPLEMENT on both channels and select EXT on the mode switch. Terminate both outputs in 50 ohms at maximum amplitude and monitor the outputs of the power supplies. This can be done by measuring at the appropriate terminal of the tagstrips mounted on the centre cross frame. The levels are as follows, measured relative to chassis and with both amplitude controls set to maximum.

Supply	Reading	Adjust	P-P Ripple
+ 55 volts	+55V ±5%	R35	20mV
+ 43 volts	+43V ±5%	NIL	20mV
+ 22 volts	+22V ±5%	R15	10mV
+ 12 volts	+12V ±0·5V	NIL	5mV
+ 7 volts	+ 7V ±0·5V	NIL	5mV
- 55 volts	-55V ±5%	R53	20mV
- 43 volts	-43V ±5%	NIL	20mV
- 22 volts	-22V ±5%	R27	10mV
- 7 volts	- 7V ±0·5V	NIL	5mV

6.3.2. Output Stage

(i) Set pulse generator to produce 1 MHz square waves with attenuator switches in 12-25 volt position and line terminated in a high quality 50 ohm load (i.e. 50 ohms ±1%).

(ii) Monitor pulse outputs and check verniers give smooth control of output levels.

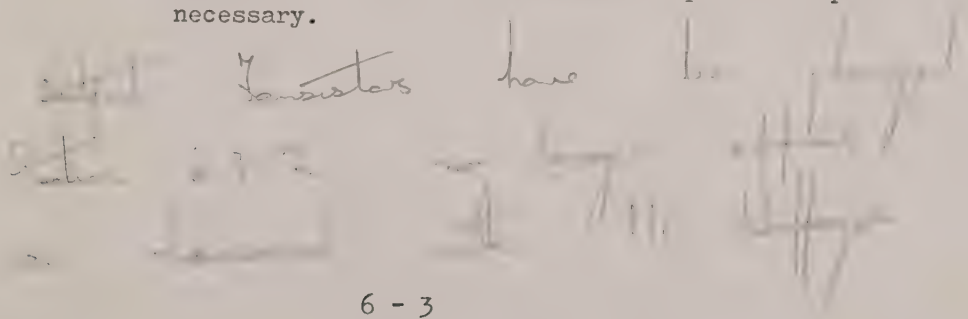
(iii) Switch positive output to COMPLEMENT and increase positive attenuator to maximum. Adjust R6 to give pulse amplitude of 50 volts with minimum overshoot and preshoot.

(iv) Monitor the positive output channel and reduce output termination value to 48 ohms, by shunting load with a suitable resistor e.g. 1 kilohm.

Adjust R26 until protection is seen to operate on the oscilloscope by noting a "chopped" waveform is present. Also note that overload warning lamp flashes. Re-adjust R26 until overload just ceases to operate.

(v) Reduce output load to 47 ohms and note that lamp flashes and that output waveform is again "chopped". Re-adjust R26 until overload barely operates with this load applied remove shunt resistor and note that unit operates normally.

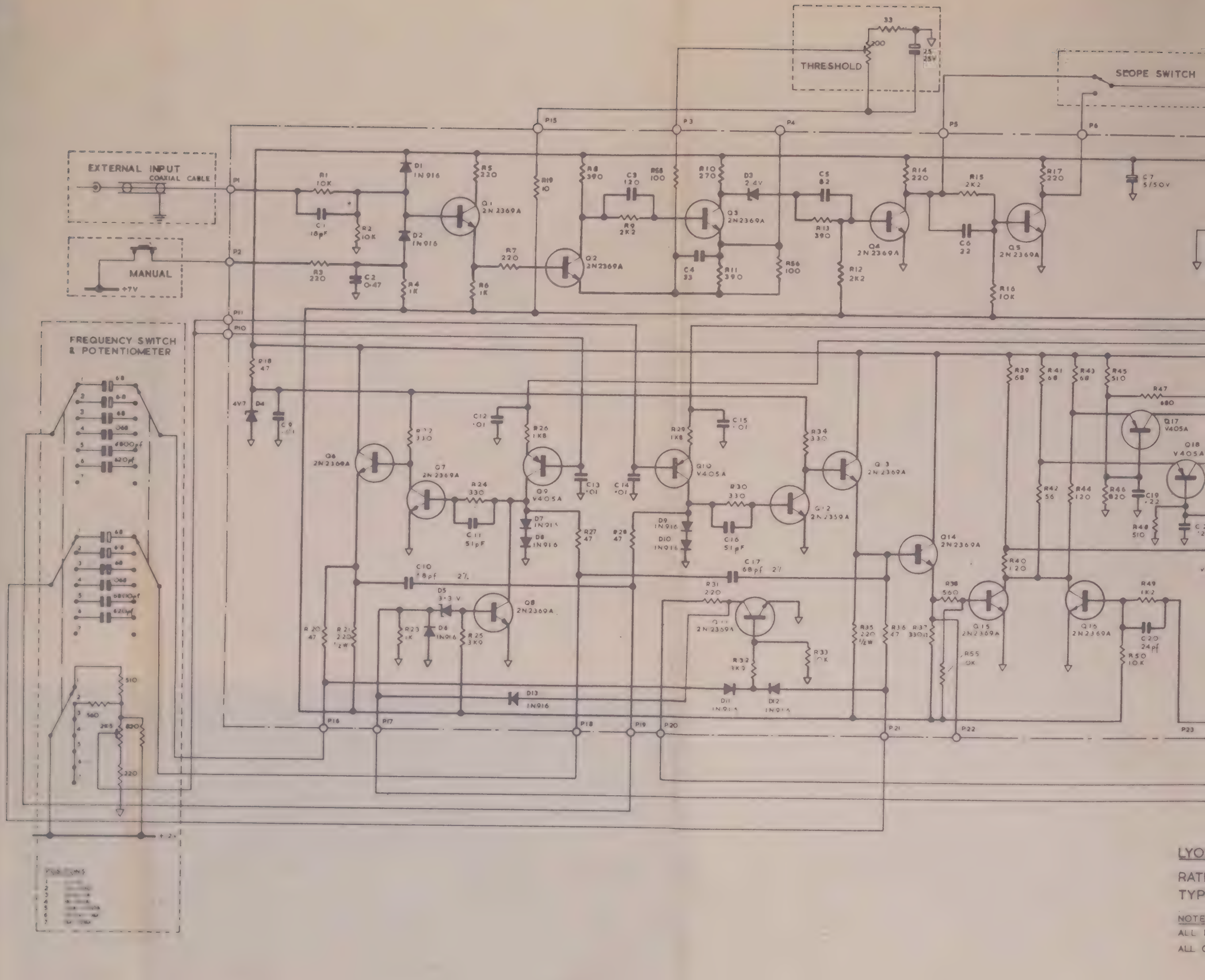
(vi) Switch positive output to NORMAL and adjust R12 for pulse amplitude of 50 volts with minimum overshoot and preshoot. Re-check COMPLEMENT output and repeat if necessary.



(vii) Repeat (iii), (iv), and (v) for negative channel using R47 and R68 respectively for negative NORMAL gain and protection circuits.

(viii) Repeat (vi) for negative COMPLEMENT gain using R54.

(ix) Check operation of unit at PRF 10 MHz, delay to minimum and width approximately 35 nSecs. The generator should operate normally with no indication of overload conditions.



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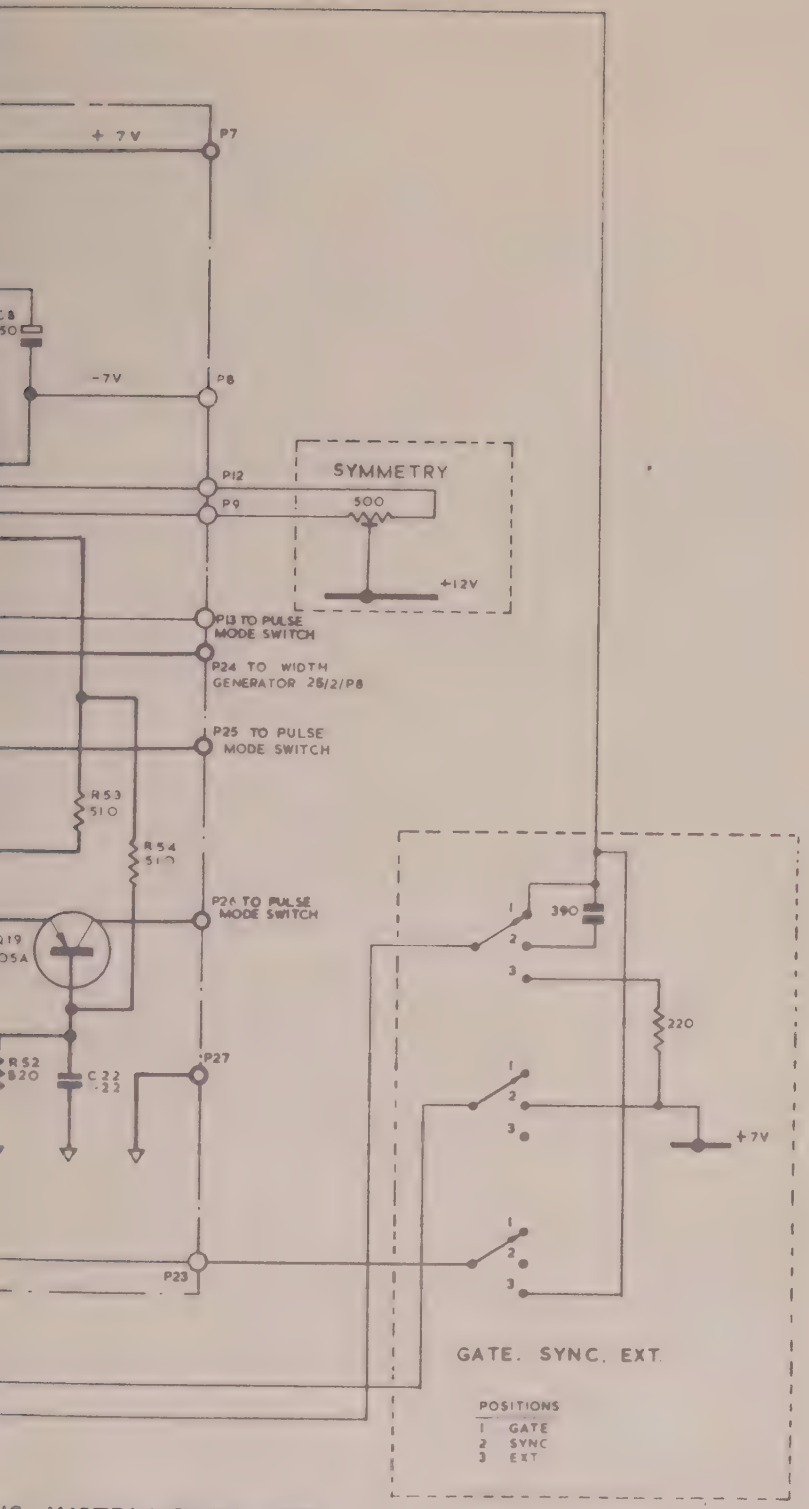
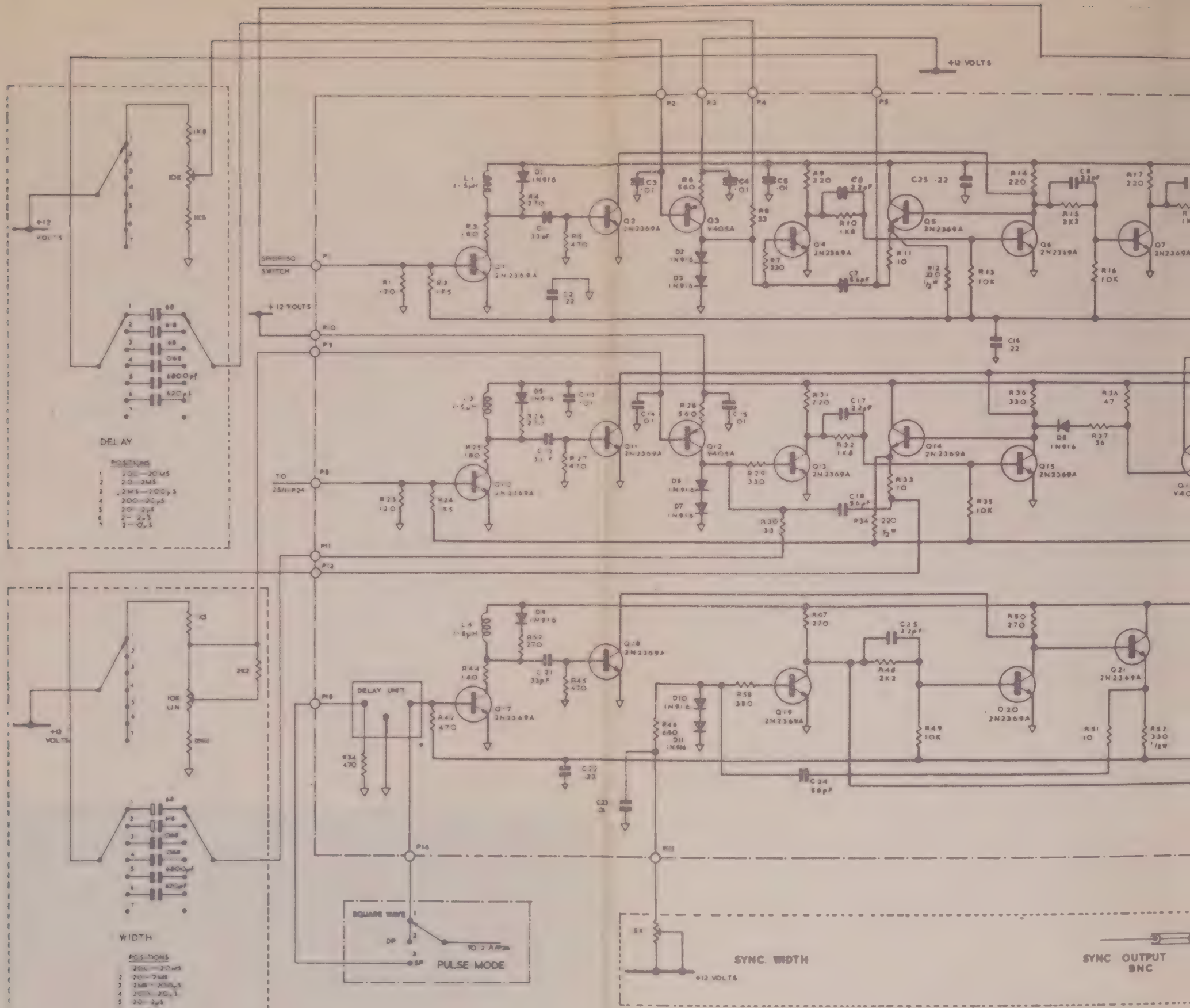


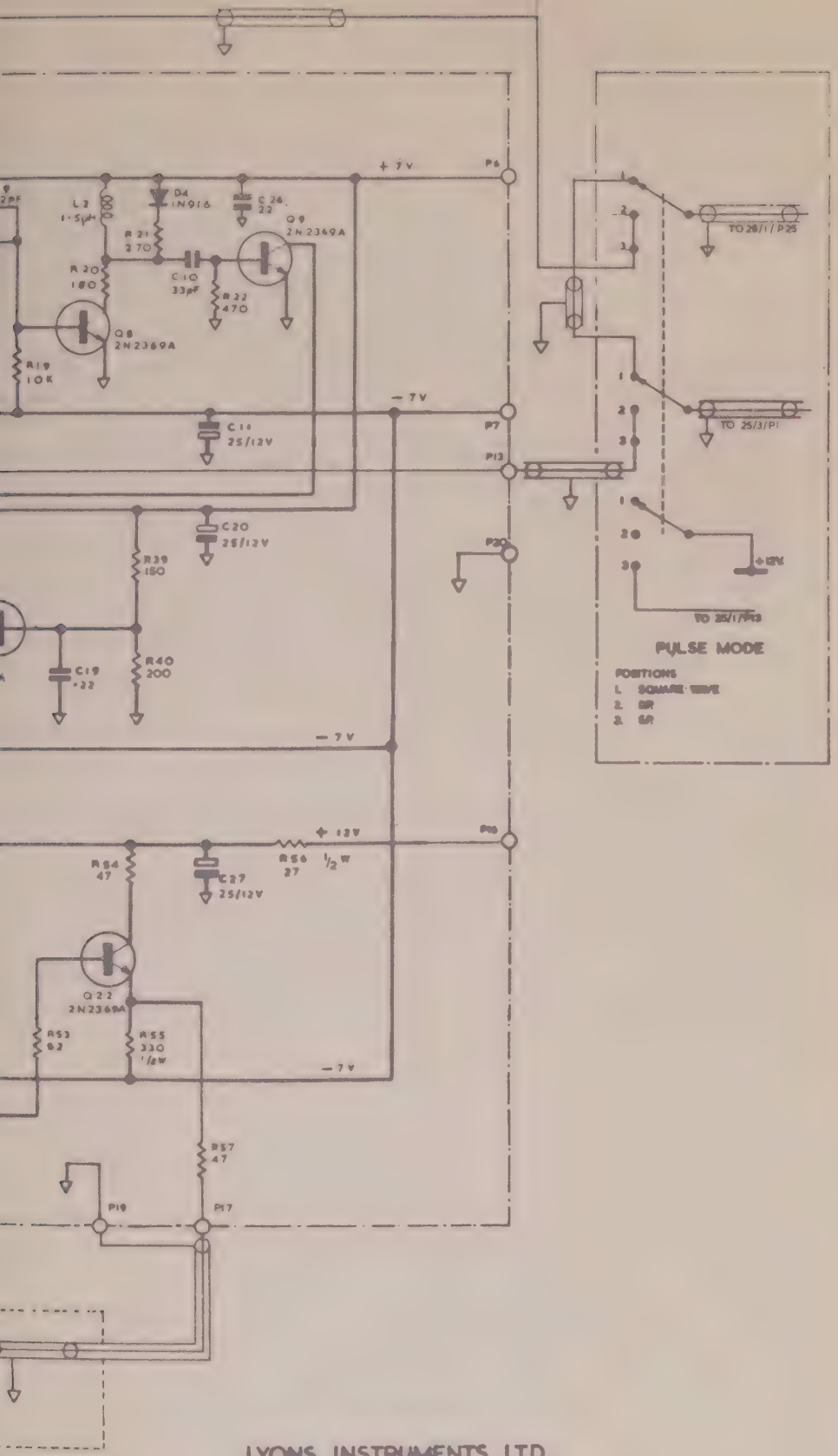
NS INSTRUMENTS LTD.

GENERATOR CCT. DIAG. PG 25
25/1

ESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE STATED
APACITOR VALUES ARE IN MFD. UNLESS OTHERWISE STATED

FIG. 1


+12 VOLTS
P2
P3
P4
P5
SPDP-SQ SWITCH
P1
+12 VOLTS
P10
P9
TO 25/II/P24
P8
P11
P12
P14
DELAY UNIT
SQUARE WAVE
DP
SP
PULSE MODE
TO 2 A/P26
SYNC. WIDTH
+12 VOLTS
SYNC OUTPUT BNC
DELAY
POSITIONS
1 20µ—20MS
2 2µ—2MS
3 .2MS—200µS
4 200—20µS
5 20—2µS
6 2—.2µS
7 .2—.02µS
WIDTH
POSITIONS
1 20µ—2MS
2 2µ—.2MS
3 .2MS—20µS
4 200—2µS
5 20—.2µS
6 2—.02µS
7 .2—.002µS

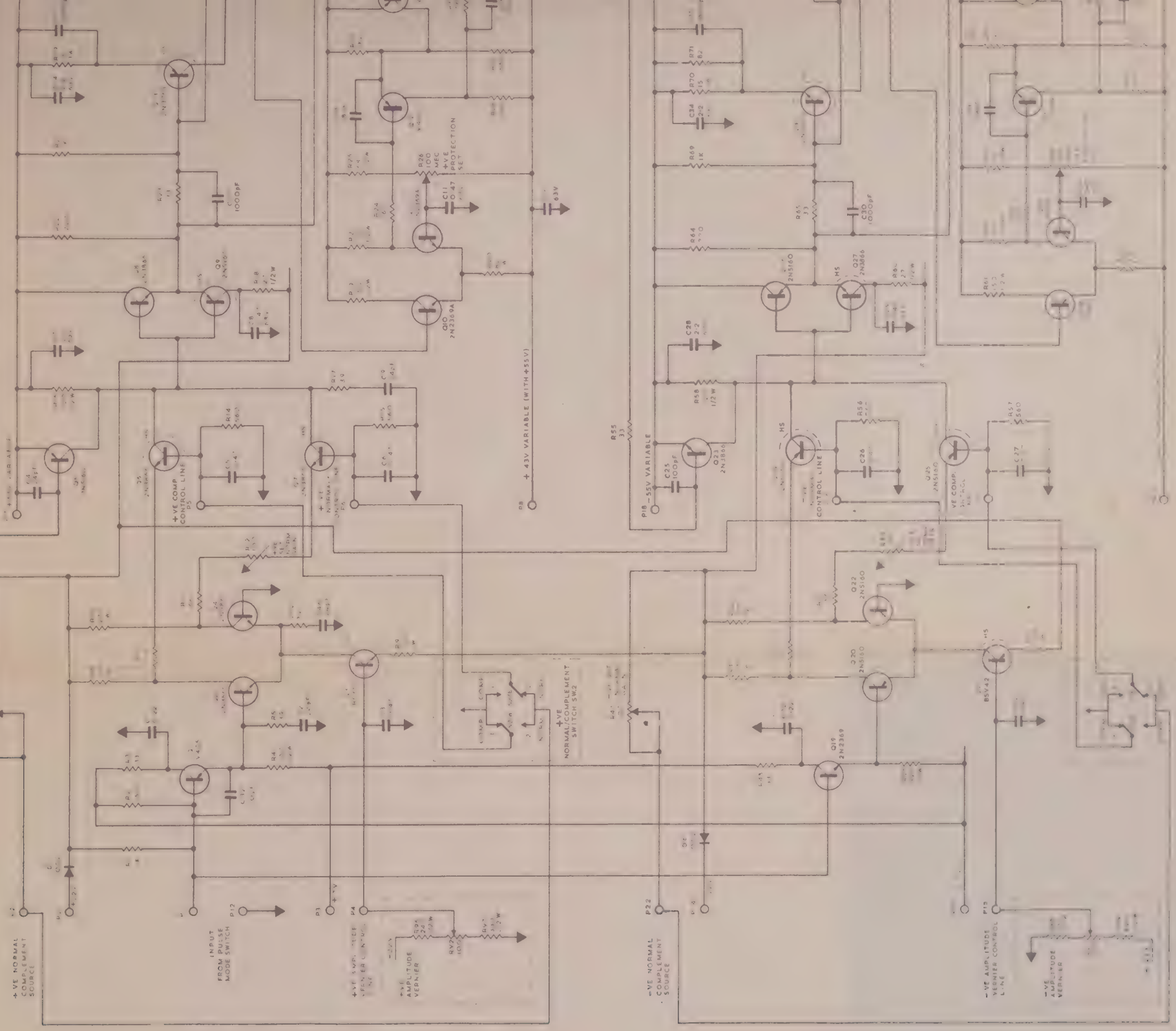


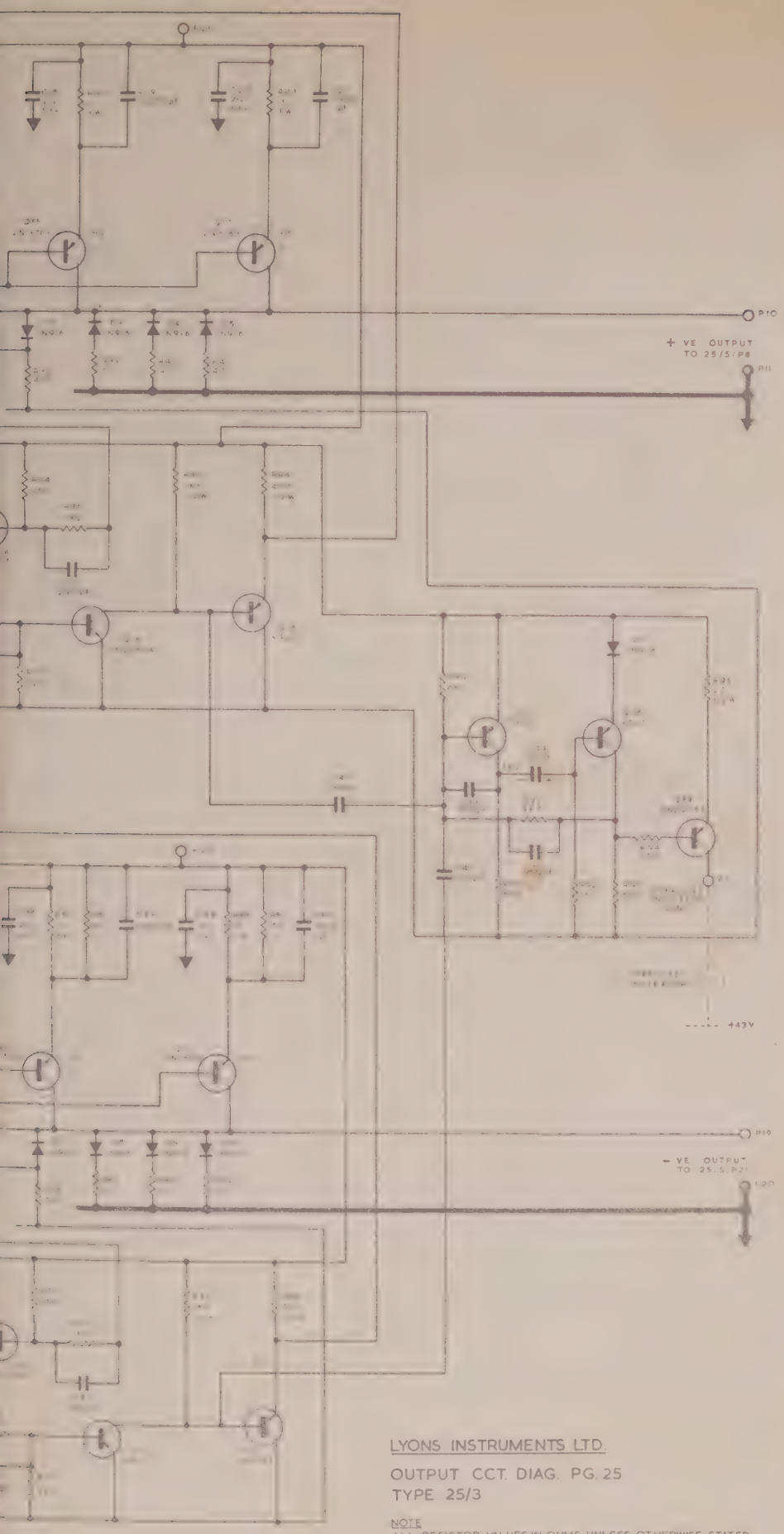
LYONS INSTRUMENTS LTD.

WIDTH & DELAY CCT. DIAG. PG. 25
TYPE 25/2

NOTE
ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE STATED.
ALL CAPACITOR VALUES ARE IN MFD. UNLESS OTHERWISE STATED.

FIG. 2


+ 43V VARIABLE (WITH +55V)
-55V VARIABLE
+VE COMP CONTROL LINE
-VE COMP CONTROL LINE
+VE NORMAL/COMPLEMENT SWITCH SW2
+VE SET COMP. GAIN
+VE NORMAL COMPLEMENT SOURCE
INPUT PULSE MODE SWITCH
+VE AMPLITUDE VERNIER
-VE NORMAL COMPLEMENT SOURCE
-VE AMPLITUDE VERNIER CONTROL LINE
-VE AMPLITUDE VERNIER

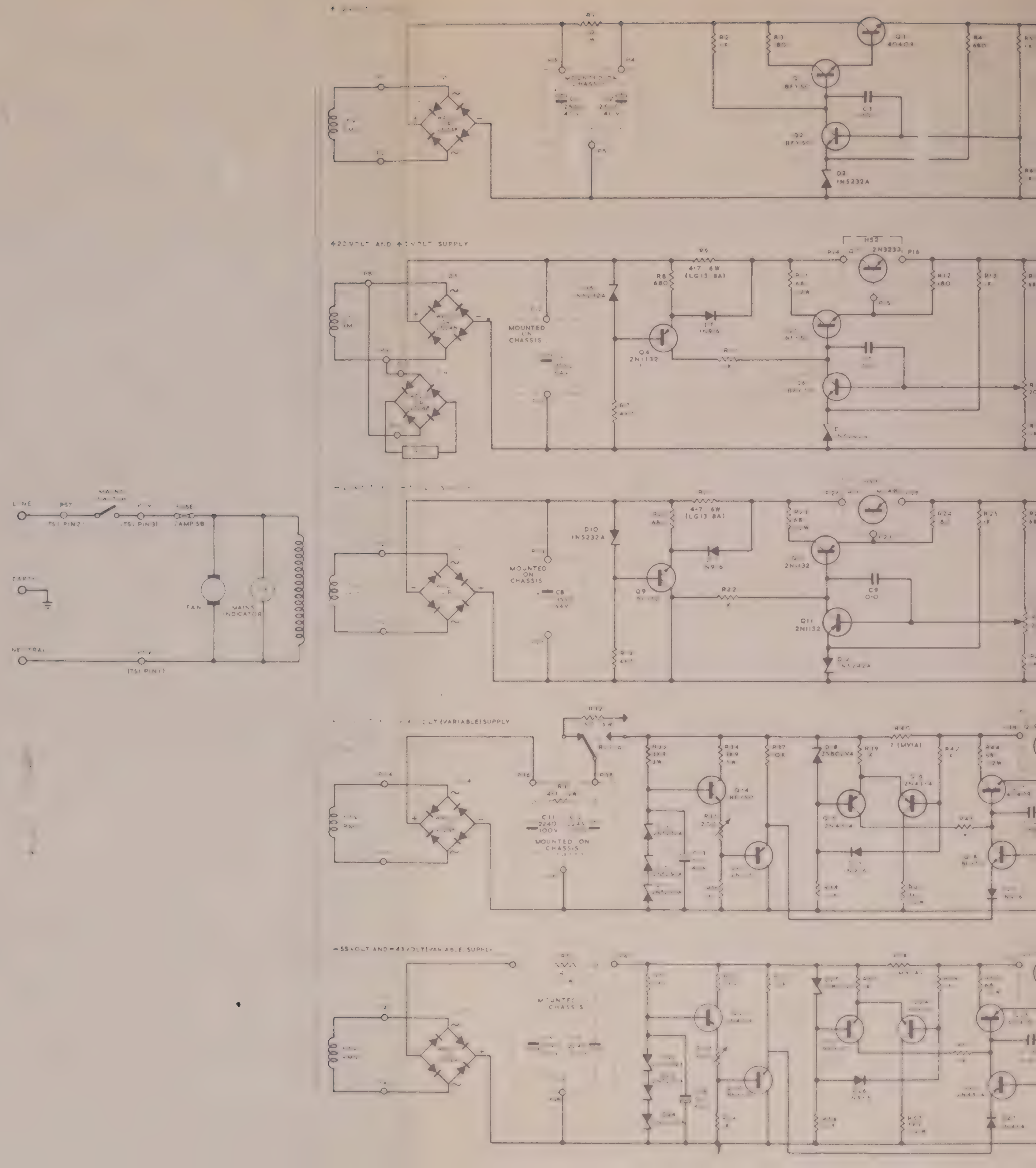


LYONS INSTRUMENTS LTD.

OUTPUT CCT. DIAG. PG. 25
TYPE 25/3

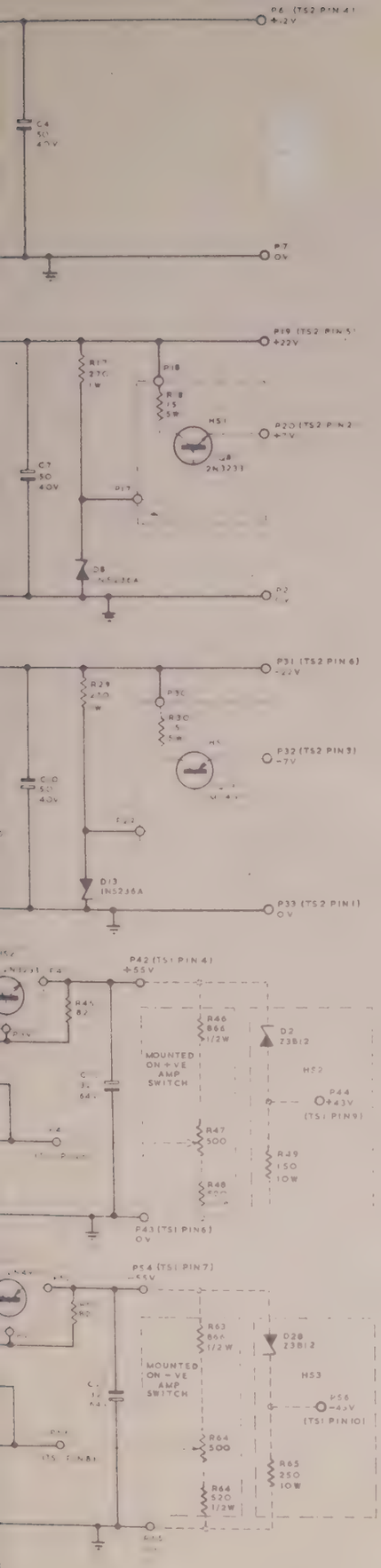
NOTE
ALL RESISTOR VALUES IN OHMS UNLESS OTHERWISE STATED
ALL CAPACITOR VALUES IN MFD UNLESS OTHERWISE STATED

FIG. 3



R1
R2 1K
R3
Q3 40409
R4 680
BFY50
C3
Q2 BFY50
D2 1N5232A
P4
P5
HS2
2N3233
P14
P16
R9 4·7 6W (LG13 8A)
R8 680
R12 180
MOUNTED ON CHASSIS
Q4 2N1132
LINE
PS7
TS1 PIN2
TS1 PIN3
2AMP SB
EARTH
FAN
MAINS INDICATOR
NEUTRAL
(TS1 PIN1)
4·7 6W (LG13 8A)
D10 1N5232A
R22
C8
64V
C9 0·0
Q11 2N1132
2N1132
R24
R25
(VARIABLE) SUPPLY
R32
R33 3K9 3W
R34 3K9
R37 10K
R39
R40
1 (MVIA)
R44
2W
C11 2240 100V
MOUNTED ON CHASSIS
P36
P38
Q14 BFY50
2N4314

. DUCT TO 297 MM MAX.



LYONS INSTRUMENTS LTD.

POWER SUPPLY CCT. DIAG. PG 25
TYPE 25/4

NOTE
ALL RESISTOR VALUES IN OHMS UNLESS OTHERWISE STATED.
ALL CAPACITOR VALUES IN M.F.D. UNLESS OTHERWISE STATED.

FIG. 4

MP MASTER
MA23376